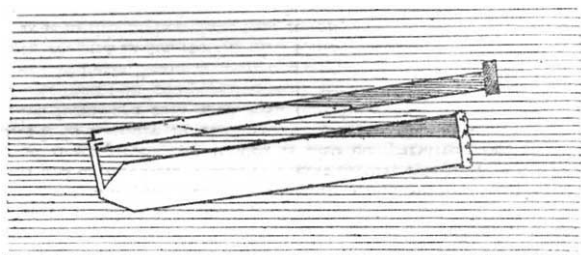


Hence, clearly, the object indicated in the title is more perfectly attained, the thinner the plate and the smaller and more numerous the holes. Very fine wire cloth would answer the purpose better than any metal plate with holes drilled through it; and very fine closely-woven cotton cloth, or cambric, answers better than the finest wire cloth. The impenetrability of wet cloth to air is well known to laundresses, and to every naturalist who has ever chanced to watch their operations. The quality of dry cloth to let air through with considerable freedom, and wet cloth to resist it, is well known to sailors, wet sails being sensibly more effective than dry sails (and particularly so in the case of old sails, and of sails of thin and light material).

An illustration was shown to the meeting by taking an Argand lamp-funnel, with a piece of very fine closely-woven cotton cloth tied over one end of it. When the cloth was dry, and the other end dipped under water, the water rose with perfect freedom inside, showing exceedingly little resistance to the passage of air through the dry cloth. When it was inverted, and the end guarded by the cloth was held under water, the water rose with very great freedom, showing exceedingly little resistance to the permeation of water through the cloth. The cloth being now wet, and the glass once more held with its other end under water, the cloth now seemed perfectly air-tight, even when pressed with air-pressure corresponding to nine inches of water, by forcing down the funnel, which was about nine inches long, till the upper end was nearly submerged. When it was wholly sub-



Water indicated by horizontal shading; Air by white paper.

merged, so that there was air on one side and water on the other, the resistance to permeation of air was as decided as it was when the cloth, very perfectly wet, had air on each side of it.

Once more, putting the cloth end under water; holding the tube nearly horizontal, and blowing by the mouth applied to the other end:—the water which had risen into the funnel before the mouth was applied, was expelled. After that no air escaped until the air-pressure within exceeded the water pressure on the outside of the cloth by the equivalent of a little more than nine inches of water; and when blown with a pressure just a very little more than that which sufficed to produce a bubble from any part of the cloth, bubbles escaped in a copious torrent from the whole area of the cloth.

The accompanying sketch represents the application to the Navigational Depth Gauge. The wider of the two communicating tubes, shown uppermost in the sketch, has its open mouth guarded by very fine cotton cloth tied across it. The tube shown lower in the diagram is closed for the time of use by a stopper at its lower end. A certain quantity of water (which had been forced into it during the descent of the gauge to the bottom of the sea) is retained in it while the gauge is being towed up to the surface in some such oblique position as that shown in the sketch. While this is being done the water in the wide tube is expelled by the expanding air. The object of the cloth guard is to secure that this water is expelled to the last drop before any air escapes; and that afterwards, while the gauge is being towed wildly along the surface from wave to wave by a steamer running at fourteen or sixteen knots, not a drop of water shall re-enter the instrument.

ON THE CLASSIFICATION OF BIRDS¹

ABOUT twelve years ago Prof. Huxley had taken up the subject of the classification of birds in his usual zealous and original way, and from quite a new point of view. Prof. Huxley, treating birds mainly from their bones and as if they were extinct

¹ Abstract of a paper read at the British Association by P. L. Sclater, M.A., Ph.D., F.R.S.

animals of which these parts of their structure only were known, had proposed an entirely new plan of arrangement, based mainly upon the characteristic variations of the palatal bones, which had passed almost unnoticed by previous writers. The author, who had long been dissatisfied with the Cuvierian system, which with certain modifications he had employed up to 1872, had in that year been constrained to consider the whole subject in order to decide what arrangements should be adopted in the "Nomenclator Avium Americanarum" (a joint work by Mr. O. Salom and himself), then ready for publication. Prof. Huxley had commenced his system with the lowest and most reptilian birds, and had ended it with the highest and most specialised. But it seemed to the author that by exactly reversing this arrangement he would obtain a scheme which would not very far deviate from that which he had previously employed for the first three orders, and would offer many improvements on the Cuvierian system in the remaining ones. Such a scheme had accordingly been promulgated in the Introduction to the "Nomenclator" and followed in that work. In the various subsequently issued editions of the "List of Vertebrated Animals in the Zoological Society's Gardens" a nearly similar arrangement had been followed. A certain amount of adhesion having been secured to this system, the author had been recently induced to devote some labour to its improvement and development. As now elaborated it did not profess to be in any respects original, except as regarded certain small details on points to which he had devoted special attention. The arrangement was in fact simply that of Huxley reversed, with slight modifications consequent upon the recent researches of Parker and Garrod on the anatomy and osteology of little known forms.

The author then proceeded to explain further the "Systema Avium" thus advocated, as shown in the subjoined table, in which the approximate number of known species was added after each Order.

ORDERS OF EXISTING BIRDS

SUBCLASS CARINATÆ (10,121 SPECIES)

	Species.		Species.
I. Passeres ...	5,700	XIII. Gallinæ ...	320
II. Picariæ ...	1,600	XIV. Opisthocomi ...	1
III. Psittaci ...	400	XV. Hemipodii ...	24
IV. Striges ...	180	XVI. Fulicariæ ...	150
V. Accipitres...	330	XVII. Alectorides ...	60
VI. Steganopodes ...	60	XVIII. Limicolæ ...	250
VII. Herodiones ...	130	XIX. Gavie ...	130
VIII. Odontoglossæ ...	8	XX. Tubinæ ...	100
IX. Palamedæ ...	3	XXI. Pygopodes ...	65
X. Anseres ...	180	XXII. Impennes ...	20
XI. Columbæ ...	355	XXIII. Crypturi ...	40
XII. Pterocletes ...	15		

SUBCLASS RATITÆ (18 SPECIES)

XXIV. Apteryges ...	4	XXVI. Struthiones ...	4
XXV. Casuarii ...	10		

In submitting this arrangement, as one which on the whole he was disposed to regard as the best to be adopted after many years' study of the Class of Birds, the author observed that it should be recollected that, although a linear system is an absolute necessity for practical use, it could never be a perfectly natural one. It would always be found that certain groups were nearly equally related to others in different places in the linear series, and that it was a matter of difficulty to decide with which of the allied forms they were best located. But, a linear arrangement being an absolute necessity, it became our duty to make it as natural as possible.

THE GREEN COLOUR OF OYSTERS

IN NATURE, vol. xvi. p. 397, mention was made of the fact that the green colour observed in oysters in certain localities is caused by a variety of navicula, to which the name *Navicula ostrearia* has been given. Further particulars of experiments made by M. Puysségur, at Sissable, are not without interest.¹

"The green slime was collected by lightly scraping the margin of one of the 'clears' with a spoon, and was put in flasks, shaken for a moment and then allowed to settle, so as to get rid of the mud, some admixture of which is inevitable. The coloured fluid, containing little or nothing besides diatoms, was then poured off into other flasks. Care and some little dexterity are requisite, as if there is too much silt or too large a quantity

¹ *Revue maritime et coloniale*, February, 1880.

of water, which is generally the case when the task is intrusted to a subordinate, it is sometimes next to impossible to concentrate the fluid enough to show the results with the desired plainness.

"Returning home, we poured the fluid into soup-plates set on a table before a window. The diatoms speedily settled on the sides and bottoms of the plates, coating them with a green slime, the thickness and tint of which varied with the proportion of diatoms present. In each plate, according to its size, we put three to six perfectly white oysters which had never been in the 'clears,' and the shells of which had previously been washed and brushed clean. In similar plates like numbers of the same oysters were laid in ordinary sea water. Twenty-six hours after the commencement of the experiment the oysters in the water charged with diatoms had all acquired a marked greenish hue; the other oysters remained unaltered. The experiment was repeated many times with identically the same results. The green colour in the oysters was found to be more decided in proportion as the water was more highly charged with diatoms. In the course of the experiments the shell of one of the oysters was perforated, so as to lay bare the mantle. After the oyster had turned green, it was laid in ordinary sea-water for a few days, when the greenness disappeared altogether. It reappeared when the oyster was replaced in fresh water containing *Navicula ostrearia*. The experiment was repeated, with like results, in the laboratory of M. Decaisne, Jardin des Plantes, Paris, to which a supply of white oysters and sealed flasks of the water containing the diatoms was forwarded.

"In the course of the experiments it was observed that by the opening and closing of their valves the oysters induced currents in the water, by means of which they drew towards them and surrounded themselves with the particles of matter suspended therein. The existence and direction of these currents were shown by the disappearance of the slime and the consequent laying bare of the sides and bottoms of the plates, the diatoms remaining only at points out of reach of the currents.

"Directed towards the buccal aperture by the cilia with which the branchiæ are provided, the naviculæ enter the stomach of the mollusc, and there part with their nutritive constituents. The yellow chlorophyll is digested and decomposed; the soluble colouring matter passes direct into the blood, to which it imparts its colour. Thus it happens that the most vesicular portions of the structure, as the branchiæ, are the most highly coloured.

"Examination of the digestive tubes of the oysters experimented upon proved the fact of the absorption of the diatoms. The stomachs, intestines, and exuviae were strewn with carapaces of naviculæ. The carapaces, being siliceous, are not affected by the digestive juices, and it would seem extraordinary that with so tenacious a covering their contents should be evolved, were it not for the knowledge of the fact that the covering is not continuous, the line of suture separating the valves composing the frustule being scarcely silicified at all."

It would therefore appear to be established beyond dispute that the green hue in oysters is due exclusively to their absorption of certain naviculæ contained in the circumambient water. The facts are in perfect keeping with the observations of growers that heavy rains (which increase the supply of fresh water) cause the disappearance of the green from the "clears," while, on the other hand, dry north-east gales, which greatly increase the saturation of the water, bring it, as it is called, "into condition."

Two points of special interest in connection with the subject remain for future investigation. These are:—

1. Does the navicula in question remain all the year in the waters where it is found in winter?

2. Is the coloration of the beds accidental or temporary?—in other words, does this alga disappear from the reservoirs when the water changes its colour, or does it become itself discoloured for a time?

H. M. C.

MODERN ENTOMOLOGY¹

IT is the good fortune of your president on this occasion to welcome you to his native heath, where our favourite science has been longer, more uninterruptedly, and perhaps more zealously cultivated than anywhere else in the New World. Here, in the last century, Peck studied the Canker-worm and the

¹ Annual Address before the Entomological Club of the American Association for the Advancement of Science, by the President, Mr. S. H. Scudder, of Cambridge.

Slug-worm of the Cherry, and in late years *Rhynchænus*, *Stenocorus*, and *Cossus*—all highly destructive insects. Here lived Harris, who cultivated entomology in its broadest sense, and whose classic treatise was the first important Government publication on injurious insects. Here to-day we have two associations for our work, consisting, it will be confessed, of nearly the same individuals, and not many of them, but meeting frequently—one in Boston, the other in Cambridge. Harvard acknowledges the claims of our study in supporting not only an instructor in entomology at its Agricultural School, but a full Professor of the same in the University at large.

In our own day the spreading territory of the United States, the penetration of its wilds, and the intersection of its whole area by routes of travel, the wider distribution and greatly-increased numbers of local entomologists, as well as the demand for our natural products abroad, have set before us temptation to study only new forms and to cultivate descriptive work, to the neglect of the choicer, broader fields of our ever-opening science. It is this danger to which I venture briefly to call your attention to-day, not by way of disparaging the former, but rather in the hope that some of our younger members, who have not yet fallen into the ruts of work, may be induced to turn their attention to some of the more fruitful fields of diligent research.

We should not apply the term descriptive work merely to the study of the external features of insects. The great bulk of what passes for comparative anatomy, physiology, and embryology is purely descriptive, and is only to be awarded a higher grade in a scale of studies than that which deals with the external properties when it requires a better training of the hand and eye to carry it out, and greater patience of investigation. We pass at once to a higher grade of research when we deal with comparisons or processes (which of course involve comparisons). All good descriptive work indeed is also comparative; but at the best it is so only in the narrowest sense, for only intimately allied forms are compared. In descriptive work we deal with simple facts; in comparative work we deal with their collocation. "Facts," said Agassiz one day, "facts are stupid things, until brought in connection with some general law."

It is to this higher plane that concerns itself with general laws that I would urge the young student to bend his steps. The way is hard; but in this lies one of its charms, for labour is its own reward. It is by patient plodding that the goal is reached; every step costs and counts; the ever-broadening field of knowledge exhilarates the spirit and intensifies the ambition; there is no such thing as satiety—study of this sort never palls.

It is hardly necessary to point out that so-called systematic work never reaches this higher grade unless it is monographic; unless it deals in a broad way with the relationship and general affinities of insects. It is not my purpose to call attention here to the needs of science in this department, as they are too patent to escape observation; but if one desires a model upon which to construct such work, one need not look further than the "Revision of the Rhynchophora," by Drs. LeConte and Horn. Rather than linger here we prefer to pass directly to some of the obscurer fields of study.

When we compare the number of insect embryologists in America with that of their European colleagues, the result is somewhat disheartening and discreditable; although perhaps the comparison would be not quite so disproportionate were some of our students to publish their notes. But take all that has been done upon both sides of the water, and what a meagre showing it makes! Of how many families of Coleoptera alone have we the embryonic history of a single species?

In following the post-embryonal history of insects there is work for all. While allied forms have in general a very similar development, there are so many which are unexpectedly found to differ from one another, that every addition to our knowledge of the life histories of insects is a gain, and they are to be praised who give their close attention to this matter. Here is a field any entomologist, even the most unskilled, may cultivate to his own advantage and with the assurance that every new history he works out is a distinct addition to the science. The importance of an accumulation of facts in this field can hardly be over-estimated, and those whose opportunities for field-work are good should especially take this suggestion to heart. Nor, by any means, is the work confined to the mere collection of facts. How to account for this extraordinary diversity of life and habits among insects, and what its meaning may be, is one of the problems of the evolutionist. There are also here some specially curious inquiries, to which Sir John Lubbock and